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A TIME FOR BURNING

Henry T. Lewis

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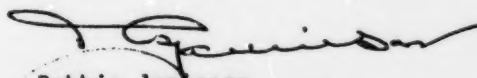
November, 1982

The Boreal Institute for Northern Studies is pleased to publish these results of the research by Dr. Lewis into the burning practices of the native peoples of northern Alberta. It will complement the film Fires of Spring, which was funded by the Boreal Institute.

The Boreal Institute for Northern Studies has been and continues to be concerned about the orderly development of the North, and that it should take place in harmony with the indigenous peoples. This research into the use of fire to enhance the environment will bring new found knowledge to many living in southern and northern climes and, with the film Fires of Spring, provide a record of the use of fire as a useful tool as practiced by earlier generations of northern native people.

The record would not be complete without particular thanks to Ms. Anita Moore, the Institute's Administrative Assistant, for 'guiding' the manuscript to completion and to Mrs. G.A. Cooke, the Institute's Librarian, for final editing.

Yours sincerely,



Robbie Jamieson
Director
Boreal Institute for Northern Studies

RSJ:am

Administration 432-4512, 432-4999
Library 432-4409
Research 432-4999
Telex Number 037-2979

CW 401 Biological Sciences Building
The University of Alberta
Edmonton, Alberta
Canada, T6G 2E9



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by

Henry T. Lewis

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FOR MOM AND DAD



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A TIME FOR BURNING

TRADITIONAL INDIAN USES OF FIRE IN THE WESTERN CANADIAN BOREAL FOREST

HENRY T. LEWIS
DEPARTMENT OF ANTHROPOLOGY
THE UNIVERSITY OF ALBERTA

Research during the last 40 years has made necessary a rather drastic reorientation of our ideas about fire as an ecological factor....As with most environmental factors, man has greatly modified its effect, increasing its influence in many cases and decreasing it in others....Properly used, fire can be an ecological tool of great value. Fire is thus an extremely important limiting factor if for no other reason than that mankind is able to control it to a far greater extent than he can many other limiting factors (Eugene P. Odum, 1971, Fundamentals of Ecology, p. 131).

Fires had to be controlled. You couldn't just start a fire anywhere, anytime. Fire can do a lot of harm or a lot of good. You have to know how to control it....It has been a long time since my father and my uncles used to burn each spring. But we were told to stop. The Mounties arrested some people....The country has changed from what it used to be—brush and trees where there used to be lots of meadows and not so many animals as before (76 year old Cree informant from northern Alberta, summer, 1975).



Taken in 1903 and showing Blackfoot Indians near Calgary, this photograph is identified as a "mock-up of starting a prairie fire". Burning practices are sometimes described by anthropologists under the rubric of "ritual activities", simply reflecting the fact that, until recently, the technological and environmental significance of habitat fires has been little understood. (From the Provincial Archives of Alberta, Edmonton.)

Fire Studies in Anthropology

If economics is the dismal science, the study of hunting and gathering economies must be its most advanced branch (Sahlins 1972:1).

In the study of hunter-gatherer societies, no aspect is quite so dismal as anthropologists' lack of knowledge of indigenous uses of fire for transforming and maintaining natural environments. Anthropologists have frequently noted, though only in passing, that hunter-gatherers, swidden farmers, and pastoralists have regularly used burning as part of their subsistence strategies. With the exception of a few recent publications, the subject of burning has received relatively little attention.¹ Prior to the 1950's, this oversight seems to be related to a lack of interest in, or understanding of, ecological questions by anthropologists. Though cultural ecology has become enormously important since then, the ways by which human populations manipulated environments with fire have been virtually ignored.

In 1954 Omer C. Stewart attempted to convince fellow anthropologists that man-made fires once had a most significant influence on natural environments. He presented both the evidence for aboriginal burning, and the more generalized interpretations being made by ecologists at that time on the significance of fires, particularly for the establishment and maintenance of grassland habitats.

The materials I have presented establish that aboriginal man has had a tremendous and decisive influence on several aspects of his physical environment. Our knowledge of such effect is far from complete because anthropologists, to a large degree, have assumed that though natives adjusted to their environment, they did not change the physical world sufficiently to warrant careful investigation. It is time that anthropologists revised their thinking on this matter (Stewart 1954:248).

In a commentary on Stewart's paper, Alfred L. Kroeber (1954), "dean" of American anthropology at that time, agreed that anthropologists had neglected the reciprocal importance of human-environmental relationships. He excused this oversight by saying that researchers had been preoccupied with the various dimensions of culture and "too busy on the whole to pay much attention to extra-cultural relations". He then, in a terse statement, dismissed the subject:

Stewart has well made his point about the Indian custom of burning and its effect upon the landscape, and this in turn leads to an interesting consideration of general

principle. For which we shall all be grateful and leave it there (Kroeber 1954:299).

Omer C. Stewart continued his studies on the importance of man-made fires (1955a, 1955b, 1955c, 1955d, 1963), but he generated little interest among other anthropologists. Though research on ecological questions became increasingly significant after the mid-1950's, the importance of burning as a means of environmental shaping and human adaptation was ignored.²

Omer C. Stewart found this lack of interest in the human impact on natural environments somewhat strange, particularly given the strong negative reaction of anthropologists to the older ideas of "environmentalism".³ Following the works of Franz Boas, anthropologists rejected the idea of environmental determinism. They did not, however, maintain that band or tribal societies played any significant roles in shaping environments. Although it was, and is, a fundamental postulate of ecology that every organism both affects, and is affected by, its environment, anthropologists continued to ignore questions regarding the former.⁴ Thus, despite a greatly expanded interest in human responses to environmental factors over the past twenty years, the thesis of man's reciprocal effect on his environment has been effectively ignored. This resistance appears fundamental to traditional anthropological perspectives.

Hunter-gatherers and Environment

Perhaps due to a lack of expertise in environmental studies or in questions of biological ecology, anthropologists have maintained that little or no impact is made on the environment by the types of societies which ethnographers have traditionally studied: populations of hunter-gatherers; nomadic pastoralists; and swidden agriculturalists—people living at band and tribal levels of social organization. Of these groups it is hunter-gatherers who are seen to have the least influence on natural phenomena, since, it has been argued, unlike agriculturalists they do not produce or control resources. Only now is the view that hunter-gatherers have the capabilities for affecting environmental changes being seriously considered (Williams & Hunn 1982). To date studies in ecological anthropology have concentrated on human responses to environmental factors and to other social groups, ignoring the human impact on local environments.

Hunting-gathering involves subsisting primarily on wild plants and animals. Unlike agriculture, hunting-gathering does not involve efforts to regulate the growth and reproduction of the life forms on which people depend. Thus for hunter-gatherers, more than

for any others, diet is determined by habitat (Plog, Jolly & Bates 1980:210).

Foragers are not responsible for the presence of the food on which they subsist; they collect and hunt food that is made available by natural forces (Cohen 1974:394);

In support of the assumption that hunter-gatherers are environmentally benign have been those ideas which picture the emergence of plant and animal domestication as being "revolutionary." Anthropological textbooks have consistently maintained that the change from foraging to agriculture represented a shift from a relatively passive to an active, dynamic relationship with nature.

The earliest culture systems developed techniques of hunting, fishing, trapping, collecting, gathering, etc., as means of exploiting the plant and animal resources of nature. But merely appropriating natural resources is one thing; harnessing and controlling them is quite another....The energy resources for culture building were greatly increased as a consequence of this increase in control over the forces of nature (White 1949:371).

...gradually, we begin to see the buildup toward the first basic change in human life This change amounted to a revolution just as important as the Industrial Revolution. In it people first learned to domesticate plants and animals. They began producing their food instead of simply gathering or collecting it Professor (V. Gordon) Childe had good reason to speak of the "food-producing revolution," for it was indeed a revolution (Braidwood 1975:92-93).

The contemporary folklore of primitive man paints the picture of a "noble savage", a kind of salutary conservationist dependent on the bounty of nature for survival. With the emergence of ecology, or at least popularized views of ecology, hunter-gatherers have been presented by some writers as representing a type of "ecological hero", intimately and passively co-existing with nature.

Throughout his long history as a hunter and gatherer, man was intimate with the natural world. He was a part of natural ecosystems in which he existed, just as were the animals that shared the same resources. He acquired his food by muscular energy. He was wholly

dependent upon the productivity of his habitat (Smith 1972:52).

At this technological level, man adjusts to an environment, changing his patterns of living to follow the cycles of an ecosystem. He has a oneness with the world of nature that modern men, and even Neolithic people, have lost (Keesing & Keesing 1971:136).

Hunter-gatherers and the "Agricultural Revolution"

Evolutionary theories have viewed the emergence of agriculture as involving progress, a more desirable way of life.

...it has to be admitted that, except for those who were able to work their way out of it, the hunter-fisher way of life was essentially a dead-end...no community whose livelihood was based exclusively on hunting, fishing or gathering has been able to share in the historical possibilities open to those whose subsistence was securely based on farming (Clark 1969:70-71).

Whether the line of reasoning for such statements was argued from the standpoint of "harnessing greater amounts of energy", or "techno-environmental efficiency", or "increased social and cultural complexity", or the "emergence of civilization", or the "advancement of science", it is all heavily laden with value judgments. Unfortunately, such broad assumptions are not fundamentally different in their basic premises than are the earliest evolutionary constructs of savagery-barbarism-civilization, or magic-religion-science. Thus, the fundamental ideas of cultural evolution were arranged against Omer C. Stewart's counter argument that hunter-gatherers significantly influenced environments.

Ecological studies in anthropology have for too long been burdened with what evolutionists have merely assumed to be the conditions of hunting-gathering societies. The fact that so many evolutionary "conclusions" were accepted--and some are still accepted--before actual field inquiries were made is one of the more unfortunate scientific anomalies of anthropology.

This has been most evident in anthropological interpretations of technological and environmental change, and is especially pronounced in discussions of the shift from hunting and gathering to agriculture.

About 10,000 years ago, some people began producing food, instead of finding or hunting

it. Rather than relying solely on available game or wild plants, they learned to plant and harvest crops and to bring various animal species under human control....Not until reliance on food production was well advanced did people begin to reshape their environment purposefully on a large scale: manipulating plant and animal species to suit their own needs; controlling space, water, and other natural resources; remodeling the land to increase productivity (Plog, Jolly & Bates 1980:105).

...viewing the material transition over long spans of time, it seems apparent that the food-producing "revolution" was the turning point. Up to that time humans had a modest impact on the physical environment because their numbers were too small and the technology they used to transform energy was limited or sharply focused in its destructive potential (Bennett 1976:134).

Though recent studies in prehistory have taken a more gradualistic perspective of what was involved in this shift (Reed 1977; Ucko & Dimbleby 1969), the idea of an agricultural "revolution" is still an important one for general anthropology. Only in the past fifteen years have empirical studies displaced the long-held and untested notion that hunting-gathering adaptations were necessarily difficult to the extreme (Lee & DeVore 1968). Yet most anthropologists still hold that hunters and gatherers are dependent upon the natural dispersion and abundance of resources. In contrast, the substantive materials presented here show that the hunter-trapper-gatherers of northern Alberta both increased and diversified available natural resources with the use of controlled burning.

Elsewhere I have argued (Lewis 1972) that fire must have played a significant role in the appearance of plant and animal domestication in southwest Asia. That hypothesis was put forward on the basis of functional analogues derived from research in which I was then engaged and what was subsequently published concerning the role of fire among California Indians (Lewis 1973). In terms of what is now known for a number of other environments, plus what follows here for northern Alberta, I would urge that the view of foragers as being environmentally passive be once and for all abandoned. Our increased understanding of the uses of fire by hunter-gatherers can lead us to asking new questions about the relevance of fire technologies in the gradual shift to agriculture. Surely, if we are to understand the role of fire swiddening in the emergence of agriculture, we must under-

stand the uses of controlled burning by hunters and gatherers. Given the almost universal practice of burning by foragers, and like practices for swidden farmers, it is inconceivable that selective burning did not play a major role in the transition from foraging to farming (Lewis 1981).

Had Omer C. Stewart's words on the significance of aboriginal burning been heeded in 1954, we would now have a much clearer, fuller picture of prevailing conditions for incipient farming as well as hunting and gathering. A few published works--Stewart's (1954) compilation of historical and ethnographic references; Day's (1953) interpretation of Indian burning in the northeastern United States; Arthur's (1975) analysis of Indian fire uses on the northern Great Plains; my own earlier study on California Indians (Lewis, 1973); and the work published here--combine to show that Native North Americans played significant roles in effecting environmental changes. The question is no longer "Did Indians alter natural systems?" It becomes "How, and to what extent?"

All of these studies in fire ecology have provided a new context in which to examine existing ethnographic information. This work is just such an ecological consideration of the role of fire in the boreal forests of western Canada. It is a consideration of customary burning practices, used until a few score years ago throughout northern Alberta. The approach taken is the same as that used in an earlier study on California Indians (Lewis 1973), which projected historical and ethnographic data against ecosystemic interpretations of the impact of fire on different vegetational zones. In the case of Indian uses of fire in northern Alberta, I have had the advantage of first-hand interviews and discussions with actual participants, people who understand the significance of prescribed fires, and who brought about specific effects of burning in the western Canadian boreal forest.⁵

Man-made Fires and the "Strategy of Ecosystem Development"

In recent years the sub-field of fire ecology has produced a corpus of its own concerning the significance of fire for the maintenance, change, and evolution of ecosystems. A number of studies and publications are now available which are potentially useful to anthropologists (particularly archaeologists) wishing to understand human adaptations, related to conditions of fire succession and ecological succession in general.⁶

The idea of ecological succession is of great importance to the field of ecology, yet it has been ignored in ecological anthropology. Although anthropologists have embraced the concept (or at least the word) ecosystem, there have been

no moves to explore and employ the ecological theory and perspectives of ecosystem development or ecological succession. Perhaps an important reason for this omission is the fact that succession involves constant change. The following definition of succession would greatly restrict its consideration in ethnographic research with the exception of a limited range of short term changes in productive activities, such as paddy fields, fishponds, swidden plots, etc. However, it could be quite usefully employed for studies in ethnohistory and prehistory.

Succession is viewed as the occupation of an area by organisms involved in an incessant process of action and reaction which in time results in changes in both the environment and the community, both undergoing continuous reciprocal influence and adjustment (Margalef 1968:27).

The understanding of the general strategy of ecosystem development, detailed by Odum (1969, 1971) is implicit to the understanding of the ecology of fire. Some main trends in developmental stages, or seres, of ecological succession relate directly to the adaptive significance of man-made fires.

Odum defines ecological succession in terms of three parameters:

- (1) It is an orderly process of community development that involves changes in species structure and community processes with time; it is reasonably directional and, therefore, predictable.
- (2) It results from modification of the physical environment by the community; that is, succession is community-controlled even though the physical environment determines the pattern, the rate of change, and often sets limits as to how far development can go.
- (3) It culminates in a stabilized ecosystem in which maximum biomass...and symbiotic function between organisms are maintained per unit of available energy flow (Odum 1971:251).

Colinvaux (1973) emphasizes that it is "opportunistic species," adapted to disturbed or bare habitats, which characterize the early stages of ecosystem development. These pioneering species are highly productive, disperse quickly, and grow rapidly, with much energy going into seed production. The pioneering stages are characterized by relatively few species, with great numbers of individual

members, the earliest of which are the weedy, annual plants.

Opportunistic species are replaced by "equilibrium species" such as perennial herbs with underground storage organs, which are better adapted to holding space than pioneer species. They, in turn, are replaced by woody shrubs and trees. The ecosystemic or seral stages which follow pioneering are characterized by more complex structures with greater numbers of species with fewer individuals. As more and more species make up mature systems, more complex associations and reciprocal adaptations evolve.

The standard phenomena of succession can thus be seen to follow from this central fact, that opportunists must be displaced by equilibrium species. The high productivity of early stages is a consequence of the strategy of opportunists in requiring large energy reserves for dispersal. The increasing biomass of later stages reflects the luxuries of structure enjoyed by equilibrium species (Colinvaux 1973:570-71).

The ecological succession pattern most characteristic of human adaptations today is of course agriculture. Land is cleared and opportunistic plants such as the domesticated grasses or root crops are planted. Depending upon the type of plants sown, the abandonment of the field could result in re-establishment of the original ecosystem. In the case of well-adapted perennials, these could dominate the field indefinitely. Where annuals have been grown, pioneering species are gradually replaced by weedy annuals and perennials. Where forests have been cleared, transitional forms of brush and trees will follow, and subsequently be replaced by more shade tolerant species as regrowth progresses.

Pioneering plant species have been most important to human adaptation. Some species of animals, particularly the ruminants and ungulates, have also played an important role. In North America this includes deer, elk, bison, moose and antelope. In the Old World the list includes sheep, goats, cattle and horses. The changing association of plants and animals throughout the pioneering and youthful stages of ecosystem development have affected man, as forager, pastoralist, and farmer. In this light, human adaptations are necessarily understood as a part of what Odum calls the "strategy of ecosystem development" (1969). For thousands of years it has been the ability of humans to alter and increasingly control ecological successions that have been the "revolutionary" changes in human adaptations.

Rappaport (1965, 1968, 1969a, 1969b; Vayda & Rappaport 1968) has emphasized the importance of looking at human adaptations in the same way that we would examine other

species: within the contexts of ecosystems. But, such an approach is an unnecessarily restrictive view of how human ecology can or should be studied. Ecosystems are not simply places in which we find plants, animals and man in cohabitation, and in this sense, humans do not live in ecosystems as they would live in houses. An ecosystem is a relational configuration. It is defined by the specific scientific inquiry to be made into relevant relationships. It is simply a conceptual device which the investigator uses to isolate and organize some, although never all, of the interrelationships in a small, arbitrarily designated portion of the world "out there". As Colinviaux states:

Ecosystems are in the eye of the beholder, concepts, products of a way of looking at nature (Colinviaux 1973:296).

In various kinds of natural communities such as meadows, swiddens, pastures, paddy fields, fishponds, etc., human populations have introduced periodic disruptions in order to exploit early stages of ecological succession. Particularly significant, is that they have developed complex ways of creating and maintaining those early stages, which are the most useful in terms of human needs, and which can be found or developed within a particular area. The oldest and most easily employed technique for this is truly Promethean: the use of fire.

With respect to the significance of fire in ecosystem development, Odum has noted:

Fire is another physical factor whose periodicity has been of vital importance to man and nature over the centuries -- whole biotas, such as those of the African grasslands and the California chaparral, have become adapted to periodic fires, producing what ecologists often call "fire climaxes". For centuries man has used fire deliberately to maintain such climaxes or to set back succession to some desired point (Odum 1971:268).

The maintenance of a fire climax is one example of what Odum terms "pulse stability":

A more or less regular but acute physical perturbation imposed from without can maintain an ecosystem at some intermediate point in the developmental sequence, resulting in, so to speak, a compromise between youth and maturity (Odum 1971:268).

Lightning fires are such natural perturbations interjected into forest, brush or grassland ecosystems. Lightning

is the single greatest cause of wilderness fires igniting millions of acres of forest, brush and grasslands each year. Human populations have had to adapt to these cyclical disturbances. The plant growth and animal associations which follow have important consequences for hunter-gatherers: consequences which can be both disruptive and productive.

In North America, the most important resources of Indian hunter-gatherers are those found in recently burned areas: bison, moose, deer, elk, hares, grouse, grass seeds, legumes, berries, bulbs. However, natural fires are much too irregular in occurrence and distribution to ensure the abundance of these resources. Also, because these fires are normally a phenomenon of late spring and early autumn, they destroy standing crops of plant materials. In some cases, they can seriously delay or fundamentally alter the pattern of plant recovery, which can adversely affect the local adaptations of hunter-gatherers.

It must be emphasized that the Indian uses of fires, as examined here and as shown for California (Lewis 1973), do not simply involve replicating or intensifying the natural fire patterns of summer. Indian practices in both California and northern Alberta differed significantly from the patterns of natural fires in terms of seasonality and frequency. In both areas, they purposefully selected those times of year—spring in Alberta, late fall in California—which were seen to be most beneficial for selected resources and which were safest. They burned on a much more frequent basis than is the case for natural fires. The pronounced differences between natural cycles of fire and the selected uses of burning by Indians demonstrate that foragers did not simply collect and hunt what nature happened to make available. Consequently, it is not simply the ecology of fire that is of concern but, more importantly, the ecology of man-made fires.

Recent experimental work on the place of controlled burning has gone hand-in-hand with the study of natural fire. Such studies, for the California area at least, have shown a remarkable concurrence between Indian burning practice and the recommendations of contemporary science. Actual practices of California Indians were drawn from ethnographic and historical sources and interpreted with reference to scientific studies on controlled burning. However, the controls which may once have been employed can only be inferred from the time of year and the relative frequency of burning. There is no first-hand knowledge available of whether or not controls were involved. In northern Alberta, though, I was able to inquire directly about the specific ways that fires were directed and contained. By controlling fires, the Indians of the western boreal forest were able to establish and maintain plant communities, and the animals found therein, at preferred stages of ecological succession.

In the context of these burning practices, seasonality is the most basic of fire control considerations. Fires set in the early spring or late fall are much less dangerous than natural conflagrations ignited during the heat and dryness of summer. Timing is important, in that fires at mid-day will burn more intensely than those set earlier or much later in the day. The particular time of day that a fire is set will, in turn, depend upon other factors such as fuel conditions. The flammability of various kinds of vegetation (grass, willows, pines, etc.) at any given time is a function of their types, moisture contents, and whether they are live or dead matter. This is most significant in terms of the differences in relative humidity among grass, brush and trees. During spring the moisture laden fuels of a forest may be all but impossible to ignite whereas the grasses of an open meadow or slough will burn with considerable intensity.

Wind is a singularly important consideration at any given time, because wind pre-dries fuels and, with wind, fires burn more intensely. At the same time, the absence of wind may result in an area being insufficiently burned, so that undesirable species are not removed. In mountainous regions the normally predictable movement of air currents, upslope at morning and mid-day and downslope during late afternoon and evening, can be employed to direct and control the intensity and extent of fires. At the same time, general weather conditions--humidity, temperature, dewpoint, and precipitation--also enter the calculation of when to or when not to burn, as well as the character of the fire once ignited.

The frequency of burning is important to the relative build-up of fuels. An unburned meadow which has become choked with brush, or a forest cluttered with deadwood, is potentially more dangerous for burning under dry conditions, and more difficult to ignite when damp. Plant communities such as meadows with poor or sandy soils which do not recover sufficiently may not carry a fire, and may be set back in terms of the desired recovery of plant growth and animal associations.⁷

The size of areas burned relates to controls in that a slough or small meadow can be burned in a shorter period of time and will not generate the greater amounts of heat characteristic of larger grassland fires. There is also less likelihood that changes will occur in the conditions for burning. Natural fire breaks such as streams, lakes, wetter vegetation, and recently burned areas can be employed to stop the movement of fires, as can the use of backfires. Man-made fire breaks were created by burning grass areas around stands of brush or trees which would be burned later, under much drier conditions. In hilly or mountainous regions slope was employed, burning downhill, with or against the wind to obtain a lighter burn, and uphill for a more intense fire.

Finally, people can be used to help control small fires along their edges. Efforts such as the use of wetted spruce boughs to beat out flames were limited in effectiveness against moving fire. However, these methods were simply not needed during burning "when it was done right."

As mentioned, these Indian controls closely correspond to the controls now used in prescribed burning. The equipment which we now see at a controlled burn is available should an uncontrolled fire condition occur. However impressive the arsenal of modern fire fighting equipment may be, it is the thorough understanding of the local conditions for burning which best prevent enormously damaging, uncontrolled fires.

The Boreal Forest

Roughly two-thirds of Alberta, more than 270,000 square kilometers, is covered by boreal forest with characteristic northern species of white spruce, black spruce, aspen, balsam poplar, white birch, jack pine (in the western part of the province, lodgepole pine), and tamarack. Along the southern edge near Edmonton, this forest region is bordered by aspen parkland with poplar groves interspersed with prairie. Where this parkland grades into boreal forest, aspen is the dominant species. Further north it is gradually displaced by spruce, particularly black spruce where areas of muskeg, or bog, become more frequent.

As in other northern forest regions, the boreal forest of Alberta is broken by numerous lakes, bogs, small meadows, and several large islands of parkland prairies, such as those at Grande Prairie, Peace River, Paddle River and in the High Level-Fort Vermilion area. The major rivers of this region are the Athabasca, the Peace, and the Hay, all of which ultimately drain into the Arctic Ocean. Except along the Rocky Mountains, the land is generally rolling or flat, since the northern forest area is geographically a continuation of the Canadian western plains.

Summers throughout the region are relatively cool and short; winters are cold and long. Mean temperatures in January vary from less than -20°C in the south to less than -25°C in the north. Recorded lows of less than -50°C are not uncommon. During January and February there are often periods of two weeks and more when temperatures remain at less than -30°C . Snows usually begin by mid-October and continue sporadically until early May or even later. Total snowfall for the year is not especially heavy, the average being about 50 inches. Frost-free periods range from 100 days in the south to less than 60 days in the north.

Various writers have emphasized the overall significance of fires in accounting for the mosaic landscape of the boreal forest, stressing its importance in maintaining a balance of "young" to "old" stages of ecological succession.⁸ Fire has been the most common source of perturbation, keeping boreal forest ecosystems productive to man (Rowe & Scotter 1973:461).

In addition to those general trends of ecosystems development which characterize fire successions, fires in the boreal forests have some distinctive conditions which must be considered in understanding the patterns of Indian burning there.⁹ Permafrost may be found in some areas of northernmost Alberta, but generally the soils remain frozen only through April or into May. Whereas the soils of southern temperate forests are colder in exposed areas and warmer under forest cover, the reverse is true in northern forests (Komarek 1971). Frosts penetrate deepest under a cover of trees and an overlay of organic material, where the insulating snow is not so deep as in open areas. Also, when soils are still frozen in the spring, water deficiencies can develop during leafing, thus reducing growth and increasing plant flammability.

Removal of cover by fire therefore contributes both to increased heat flow into the ground in summer (less surface organic insulation) and to decreased heat outflow in the winter (more snow insulation) (Rowe & Scotter 1973:456).

Thus, one result of fires is a quicker warming of burned-over areas, which can induce an earlier and longer period of plant growth. In addition, Rowe and Scotter note the argument for "nutrient lock-up" which occurs in northern climates due to the slow breakdown of detritus materials.

Allusion has been made (in this article) to the accumulation of humus in northern climates due to slow breakdown rates. Fire is believed by some to be the necessary agent of mineralization, restoring plant nutrients for recycling (Rowe & Scotter 1973:456-57).

Viereck (1973:479-80) has detailed a decrease in acidity, together with increases in nitrogen, calcium, and to a lesser extent, potassium and phosphorous, as some of the effects of fire. This release of nutrients in the warmest portions of the soil helps to explain the improvement in productivity during the early stages of succession. In later seral stages, such nutrients are unavailable in frozen soils or cold organic layers. The low intensity of summer rainfall, the length of time during which soils remain frozen, the moisture holding capacity of organic layers, and the rapid vegetation of burned-over areas also mean that erosion

and water run-off are minimal in comparison to temperate forest regions (Vioreck 1973:480).

Because faunal successions are dependent upon plant successions, with animals requiring a number of habitats for food, shelter and mating, the mosaic boreal forest provides an optimum range of environments for the greatest number and populations of species.

...any influence tending toward diversifying the landscape at large and small scales will increase the diversity of the fauna as well as the population density of some species. By maintaining a mosaic pattern in the boreal forest, fire assists in the maintenance of diverse wildlife populations....The pattern and scale of burned and unburned patches is probably critical in determining the suitability of habitat for many species (Rowe & Scotter 1973:458).

Browse for moose and deer is both more abundant and of superior quality in recently burned areas, since fire induces the relative quick growth of deciduous shrubs. During later stages of succession, trees shade out shrubs, the supply of browse is reduced, and so, in turn, are the numbers and density of browsing species. The lichens found in mature forest stands are the principal winter forage of the barren-ground caribou. The recovery of these plants following fire is exceptionally slow, yet, fires do not destroy or impair all caribou forage areas.

In the southern limits of the barren-ground caribou's winter range, fire sometimes destroys thick carpets of bryophytes in upland forest and in muskegs, thereby making those forests more productive for lichens and other forage plants (Rowe & Scotter 1973:458).

Sharp-tailed grouse are found in association with recent burns, while spruce grouse are found in mature boreal forests. Snowshoe hares are frequently found in large numbers in the young stands of aspen which frequently follow forest fires. Bears also frequent recently burned areas to feed on berries commonly found there.

The variety of fur-bearing species found in northern Alberta represents the wide range of adaptations to various successional stages of boreal forest. Muskrat and, later, beaver are associated with recently burned habitats, while marten, fisher and red squirrel are characteristic of mature spruce forests. Fox, coyote, wolf, and lynx are linked through food chains to prey species and to a range of habitational types, and successional stages of boreal forest.

What Leopold (1948) calls "range balance" is achieved in the existence of a mosaic of habitat types.

The effects of wildfire, whether short-term or long-term, are complex and must be related to the nature of the forest burned, size of the area burned, intensity of the burn, distribution of unburned habitat types in relation to the burn, and the biology of all animals in the area (Rowe & Scotter 1973:460).

The conclusion of ecologists in general, and fire ecologists in particular, is that the attempts at fire exclusion have had profound, and often undesirable effects upon the management of wilderness areas. Controlled burning has been tested experimentally in areas throughout the Canadian boreal forest and the introduction of prescribed fires is now widely accepted, though the most effective methods of such burning have not been agreed upon.

If the major goal of such areas is to perpetuate samples of as many natural landscapes as possible—with the recognition that fire is an inseparable part and natural agent in the ecology of ecosystems—then land managers must "unsell" the false impression that all fires are bad and be prepared to use both prescribed fires and natural lightning fires in landscape management (Rowe & Scotter 1973:461).

The point to be made and subsequently documented in this publication is that prescribed fires were once part of the Indian's own pattern of "landscape management." Obviously, the Native people of Alberta lacked the formal scientific expertise and sophisticated equipment of modern forest management practices. However, their selective employment of fire for boreal forest adaptations indicated an understanding of both the general principles and the local specific environmental relationships that are the subject of modern fire ecology. Though their overall goals in burning were different from ours, and though their cultural imagery was distinct from that of scientific paradigms, Indians understood the essential dynamics and relationships involved in what is today the fire ecology of boreal forests. They understood and practiced controlled burning as a part of hunting-gathering subsistence activities.

As humans with a total subsistence commitment to the dynamics of boreal forest production and organization—not like our compartmentalized interests in lumber, minerals, farming, recreation, etc.—they would of necessity have learned about the advantages and disadvantages of fires. Had they not known, or had they been indifferent to the impor-

tance of fire, their adaptations to boreal forest habitats would have been precarious indeed.

Indians of Northern Alberta

The forested areas north of Edmonton were occupied by three Athabaskan groups until the early part of the eighteenth century: the Beaver occupying the large central region from the North Saskatchewan River to the Peace River; the Slavey Indians along the northern portion, extending into the Mackenzie River and the Northwest Territories; and the Sekani in the northwest extending into the upper Peace River area of British Columbia.

With the introduction of the fur trade and additional pressures emanating from eastern Canada, this distribution of native populations was significantly disrupted. As early as 1725 Cree Indians, Algonkin speakers from western Ontario and the James Bay region, were pushing into the parkland and southern boreal forest of eastern Alberta. The movement and displacement of indigenous populations coincided with developments in the northern plains, where Assiniboines paralleled and bordered on, the Cree expansion westward. During the latter part of the eighteenth century the Athabaskan Chipewyan entered northeast Alberta, displacing still more populations of Slavey, Beaver, and Cree.

All but the Sekani, who were eventually pushed into British Columbia, are represented in the contemporary distribution of native populations in Alberta. Added to the relatively large number of Cree communities and smaller populations of Beaver, Slavey and Chipewyan, have been large numbers of Metis, the predominantly Cree-speaking descendants of so-called half breeds. Today, the Metis are, in effect, Indian communities without treaty status. The once distinct cultural mixtures of Scottish-Athapaskan, French-Athapaskan, and French-Cree are now little different from those of nearby Indian groups.

Unlike Indians to the south, those in northern Alberta were able to continue the traditional patterns of subsistence-based hunting, fishing and trapping long after White contact and settlement. However, over the past 50 years Indian communities gradually lost this relative economic independence. The final phase of their hunting-trapping subsistence pattern involved residence near a trading post with males engaging in a number of trips to more or less distant traplines. Though trapping still persists, most individuals in the native communities of northern Alberta are now dependent upon wage employment or government welfare support. As concerns isolation, no more than half-a-dozen communities still lack access roads, and even these can be reached by motor vehicles during the winter.

By World War I the traditional lifestyles, which included prescribed burning as an integral part of subsistence technology, were on the decline. This was coupled with greater, more effective efforts at fire exclusion and suppression by environmental protection agencies. By the end of the First World War such burning was already restricted to, and carried out surreptitiously in, only the most remote and isolated parts of the province. Consequently, in the southern portions of the boreal forest only the very oldest individuals, those 80 years and more, have any direct knowledge of such activities. In what were once the more isolated portions of the central region, in a line from Manning to Fort McMurray, some informants in their early seventies can still be found. Because there were few roads north of the Peace River district before 1940, knowledgeable informants living in the most northern sections of the province, from the High Level-Fort Vermilion district in the west to the Fort Chipewyan area in the east, are sometimes as young as 60 years of age.

The argument may be raised that the Indians of northern Alberta were not true hunters and gatherers since they were heavily dependent upon trapping and market exchange. However, I would prefer to ignore what is essentially a taxonomic question. I would simply counter that whatever classification one may wish to assign them, the designation must take note of the fact that until World War II, hunting and to a lesser extent, gathering, were the dominant adaptive strategies in boreal forest habitats. Whatever else the addition of trapping involved, the Indians' relationships to specific plant communities were not fundamentally altered, though the relative significance of particular components of local ecosystems did change in response to economic and historical circumstances. Thus, even though external market factors became increasingly important, the local relationship of trappers to fur-bearing animals remained closely linked to hunting practices.

In any event, my interest is not a typological one, it is a relational one: a system of man-environmental relationships that included the technology of prescribed burning, selectively and variably employed, to increase both the diversity and productivity of plants and animals. The ways in which fires have been used since the period of European contact undoubtedly varied as the Indians responded to changing conditions: the elimination of woodland bison; variations in market significance of certain fur-bearing species; invasions of other groups such as Crees, Chipewyans, Whites; technological changes such as the introduction of rifles, steel traps, etc.; acquisition of horses; displacement and decimation of human populations; and ultimately, prohibition (though never total suppression) of burning itself.

Articles by Stewart (1951 etc.), Day (1953), Thompson & Smith (1971), Martin (1973), and others have noted the pan-Indian practice of using fire to alter local habitats. With specific reference to the boreal forest regions of Alaska and Canada, Lutz (1959) has noted the same conditions in the far north. Studies in paleoecology indicate uses of man-made fires during the past several thousand years (Davis 1965:307; Wells 1970:199-200). Also, preliminary research by Lewis & Schweger (1973) suggests the earliest uses of fire for achievement of environmental change in the New World followed the Wisconsin glacial period.

References to Indian burning in northern Alberta by explorers and settlers are relatively few, sketchy at best, and do little more than confirm that burning did take place. However, one important remark by Dr. George M. Dawson, a biologist with a Canadian Pacific Railway survey party in 1879, reported the following:

Whatever theory be adopted, and may have been advanced, to account for the wide prairies of the western portion of America further to the south, the origin of the prairies of the Peace River is sufficiently obvious. There can be no doubt that they have been produced and are maintained by fires. The country is naturally a wooded one, and where fires have not run for a few years, young trees begin rapidly to spring up. The fires are, of course, ultimately attributable to human agency, and it is probable that before the country was inhabited by the Indians it was everywhere densely forest-clad (Macoun 1882:125).

Unlike previous research on California Indians (Lewis 1973), which depended almost entirely upon ethnographic sources, there are no anthropological references to burning as practiced by the Indians of northern Alberta. In fact, the ethnology of Indians in northern Alberta is still very limited (Murdock 1972).

Field Interviews

The initial interviews upon which this study is based began in late summer 1974 and involved two older Native people, former residents of Grande Cache. One of these could, or would, only acknowledge that he had heard of the custom by which people burned meadows. The other individual was extremely knowledgeable, and in several conversations yielded a wealth of information on the system of causes and effects of fire in different micro-environments. This information provided the incentive for work carried out over the following three summers.

It was originally anticipated that interviews would take me beyond the provincial limits of Alberta. For a number of reasons, not the least of them budgetary constraints, the plan to go further afield was dropped. More important, however, was the fact that there was, and still is, a wealth of information to be found within Alberta itself.

Research during the summer and fall of 1975 entailed locating possible informants. Of the many people interviewed between June and October of 1975, 37 were found who had some knowledge of traditional burning practices. Although this was approximately three times the number originally hoped for, it did not represent the universe of possible sources. During the summers of 1976 and 1977 an additional 20 persons were interviewed.

Those informants south of the line between Manning and Fort McMurray (about 57°N latitude) were in their late seventies or older. They recalled events which occurred when they were boys or young men around the turn of the century. According to both Whites and Natives, traditional burning practices continued on a considerable scale in the High Level-Fort Vermilion area, right until World War II and the construction of the Mackenzie Highway.

Working with informants in their late fifties and early sixties, I decided to concentrate the final summer's inquiries on the Upper Hay River Band to carry out more intensive interviews at the Hay Lake, Meander River and Bushe River reserves during the summer of 1976. At the same time, permission was given for a graduate student, Ms. Theresa Ferguson, to initiate work on a combined ethnohistoric and paleoenvironmental study of the uses of controlled burning and documented changes in subsistence practices.¹⁰ Between April, 1977, and January, 1978, a film, Fires of Spring, was made using interviews with Slavey elders. The narrative of this documentary-ethnographic film juxtaposes traditional Indian practice and filmed sequences of contemporary life on northern Indian reserves.

Though work was concentrated in the northwest part of Alberta during the final periods of study, this publication is a generalized picture of how fire was used throughout Alberta's boreal forest region. At this general level, variations in practice between regional forest subtypes do not appear. Only extended empirical studies might have revealed a measurable difference between, for example, the Hay River boreal forest region, with fewer aspen and jack pine, and increasing amounts of black spruce, and those boreal forest subtypes to the south. Because of the fact that black spruce-muskeg areas were the winter feeding grounds for caribou, it may be that burning was less extensive prior to the introduction of trapping. However, without

extended studies, which are now impossible, such differences cannot be meaningfully considered.

A greater resistance to interviewing was expected than was actually encountered. There were some individuals who seemed to know more about the topic than they were willing to tell, and some who simply would not talk about burning with a stranger, particularly a white stranger. After more than seventy-five years of having been told that the practice was inherently bad and subject to prosecution under law, this reaction was not unexpected. The amazing thing was the number of individuals who were willing to discuss the subject. The general approach was to explain the recent advocacy and selective use of controlled burning by specialists in forest management. In most areas of northern Alberta the Alberta Forest Service has implemented modest programs of "fire hazard reduction burning", in varying degrees from one forest district to another. Both White and Indian residents seem to be aware of this development. After discussing this, and recent ecological conclusions about the effects of controlled burning, I added that it was important that people understood that this kind of knowledge and practice had been an important consideration in Indian adaptations to the boreal forest.

During the first interviews, I was uncertain of all the areas on which information might be gained. After the first month, a list of topics for discussion with informants was developed, primarily to ensure that the same general questions would be covered in each interview. Questionnaires, as such, were not used; I was attempting to establish a complex of accessional information. As new information and insights emerged, they were simply added to the topics discussed in subsequent interviews. As my knowledge grew, I was able to ask better, more appropriate questions, and in several instances I was able to re-interview informants about "new" information to confirm interpretations. Of more than 50 individual interviews, the relative "success" varied from eight or ten highly knowledgeable and articulate informants, to an equal number who could, or would, do little more than confirm that they had once burned meadows or that they had observed others doing so.

Since the subject of traditional burning practices has remained a sensitive one, it would have been difficult to elicit the detailed, qualitatively significant information required by the study, without an ability to ask relevant questions, and to discuss informants' answers in a knowledgeable way. While not an expert in fire ecology, my previous studies in this area, plus personal experience in forestry work over an eleven year period, helped immensely in conducting meaningful interviews.¹¹

Clearly the type of research carried out for this study

did not involve the more traditional approaches used in ethnographical field studies. Unfortunately desired ethnographic contexts for traditional practices of burning no longer exist. With indigenous practices virtually eliminated there was a certain urgency in gathering information, since informants were few, advanced in age, and spread over a large geographical area.¹²

A pattern of extended interviews seemed the most reasonable approach to collecting as much information from as many individuals as possible. Although based only on recall of earlier practices, the information provided by informants parallels the findings of published studies on the ecology of fire and controlled burning. Because the same information was consistently gained from people living in widely separated communities and from different cultural traditions, a form of comparative testing was achieved.

The Patterns of Indian Burning

I have often been asked, by both academics and non-academics, "Why did Indians burn?", the implications being that there was a specific reason for burning. A common explanation in the literature is that burning was done to drive game. While this appears to have been the case in more temperate climatic zones (e.g. those described by Hallam, 1975, for Western Australia), this was never given as a reason in northern Alberta.¹³ Our view of this environmental question is essentially a narrow one of cause and effect, whereas Indian informants clearly recognize the multiple effects of fire, which could be employed in a variety of settings.

In answer to my specific questions about the steps involved in burning meadows, sloughs and other areas, "it all depends" was a frequent response. Because all burning depended upon the prevailing conditions and available controls, it was impossible for informants to outline specific procedures in the absence of specific instances. In truth, preparations for burning were almost entirely mental: evaluations of why, when, where and how. The lack of observable steps created a surface casualness toward burning which masked the detailed knowledge of fire's multiple environmental effects. Sure knowledge of particular places and immediate variable factors ensured the feasibility and long-run success of controlled burning over several thousand years.¹⁴

In presenting this narrative, I have made liberal use of comments made by informants during our discussions, some taken from tape recordings made at the time, others reconstructed from field notes. These comments express, sometimes rather eloquently, the insights by which an indigenous people effectively related to the northern boreal forest. However,

the organization of these comments is my own, not that of the people interviewed. Headings do not indicate folk categories and do not necessarily represent separate, discrete situations. They are merely a means of organizing the data.

Meadows

All informants agreed that meadows had to be maintained by burning. Within the boreal forest of Alberta, meadows are widely scattered, and they are normally associated with the local buildup of river, stream, and lake sediments. Further north, boreal forest openings are increasingly those of bog and swamp until, well above 60° N latitude, boreal forest gives way to tundra.

Informants were well aware of the association between meadows and the dark or peat soils in which grasses and successively aspen and white spruce grow. They emphasized the fact that if meadows were not periodically burned they would be taken over by brush and forest, and that the loss of grasslands to brush and trees resulted in increased fire danger.

It used to be all prairie here; now it's mostly forest. My father told me that long time back there were plenty of buffalo here, all the way (north) to Cold Lake. We were Plains Cree, not like those bush people up north. Now it's all bush here too (Cree, 72, Frog Lake area).

The size of meadows varied from several acres to a full section (640 acres) to a township (36 square miles) or more in size. Some of the largest areas, small prairies in their own right, were being burned until just prior to World War II, in the High Level-Fort Vermilion parkland region. Larger meadows adjacent to settlement areas would be fired by most or all of the men from a community, more or less at the discretion of older men. Women, it was reported, did not participate in burning. Smaller meadows might be burned by a few men, or even a single individual. The number of individuals required was a function of meadow size and proximity to the main settlement area.

Why the bushes so thick is because...they stop burning—the Indians stopped burning...from about five miles from here you could see straight prairie right to Chance Lake and that timber. Again, from there, the same thing towards Bushy (River). Did you ever see them prairies? My goodness, I even remember. It was really prairie...just prairie, you know, (and) here and there you see little specks of woods and if there were trees there they were

quite huge (Beaver woman, 69, High Level area).

All informants agreed that spring burning usually occurred from mid-April to late May in most regions, but could be somewhat later in the northernmost portions of the boreal forest. However, climatic conditions, not the calendar, determined the schedule for burning in any given year. It began when the snow cover melted from the meadows. Though late season snows might persist into mid-May or even June, when the winter snowpack was gone and the grasses were sufficiently dry, meadows would be fired.

In the spring when there is still some snow in the bush that's the only time most people could burn the open places. It is then that people think that it is best to start the burning. There are a lot of places they don't burn; they don't burn all over. But there are many places people know to burn. In time many animals go there; some, like the beaver, about four to five years after. Especially the bear because the new bushes of berries growing in the burned places. Bears live not only on leaves and other plants; they also live on berries. They eat all kinds of berries at any season (Slavey, 69, Meander River area).

In early spring, the vegetation surrounding the meadows is still damp, and snow may still cover the ground underneath brush and trees. However, it is not merely the presence of snow that is the fundamental impediment to the spread of fire, but the much greater dampness of the surrounding bush, trees, and grasses. In fact there may be little or no snow but these moisture laden forest fuels will not ignite under such conditions. On the meadow itself soils remain wet or frozen since, in spring, night temperatures regularly drop below freezing. Thus, combinations of ground moisture and frost protect subterranean portions of grasses and other herbaceous plants against fire damage.

Meadows were normally burned each year. Those with lighter growth cover were burned less frequently if plant detritus could not carry a fire satisfactorily, or if fire might set back rather than enhance plant growth. If the budding of brush or sprouting of grasses had begun, burning did not normally take place, due to increased danger and decreased benefits. On the other hand, an extended, wet spring might seriously reduce the size and effectiveness of areas that could be burned, one reason for the burning of some areas in late fall.

All informants emphasized the importance of spring burning, but one-tenth of those interviewed said that some

meadows were burned in late autumn. This was done after one or two early snowfalls had melted or been blown clear of the meadows, but still remained as a ground cover in the forest. While all agreed that fall was a more dangerous time to burn and that fall burning was always an adjunct to spring burning, its benefits included a headstart for plant growth the following spring. Once the snow had melted and the upper layers of soil became heated, the growth of grasses, regardless of the spring weather, would begin much earlier. According to one informant, trappers used fall burning in areas they knew they would not reach in time for spring burning.

Sometimes we burned in the fall. It has to be done at the right time because (the fire) might get away. You wait until there's snow in the bush and it's kind of wet there. The grass burns real good but it stops when it gets to the bush. Then, in the spring you get better grass (Slavey, 79, Hay Lake area).

Fall burning provided a type of insurance against a bad spring or absence from an area to be burned, but it had some important disadvantages. Surrounding vegetation could catch fire much more easily, and, informants claimed, fall burning did not produce as full a cover of spring grass as could spring fires.¹⁵ Fall burning meant most winter forage was removed and that game would necessarily abandon such areas until spring growth emerged. The impression given by the informants was that fall burning was restricted to small areas and ones that were not exploited while on winter trapline.

Used to be we lived in teepees all year. Moved round a lot. One place in the fall we'd burn, another place in the spring we'd burn that....Country was a lot more open then and wasn't so hard to travel. Not like now. You can hardly travel in the bush and it's not so good for hunting. I haven't been on trapline in a long time now. So much brush you can hardly get through (Cree, 70, Fort Vermilion area).

The time of day for burning, like the time of year, was dependent upon fuels, moisture, wind, surrounding vegetation, lateness in the year, size of the area, natural fire breaks, and general weather conditions. Vegetation might be examined for moisture content by breaking twigs.

Continued burning gradually extended grassy areas until such time as settlements, hunting areas or traplines were abandoned, and the subsequent prohibitions against burning practices allowed the forest to advance once again. One

informant explained that movement of traplines occurred as hunting and trapping resources declined, a consequence of both natural cycles of abundance and human pressures on game. These pressures were not simply the result of overkills but were also a partial consequence of the fact that game animals tend to avoid areas where hunters had been previously successful. This gradual shifting of hunting and trapping areas meant that burning alternated between expanding grasslands and those abandoned in previous years.

Firebrands or simply matches would be used to ignite the dry grass. A light wind, sufficient to carry the fire to a good burn, was desired. Late in the burning period a strong, drying wind meant that the fire might be postponed or set during the evening, when winds lessened. Natural firebreaks or backfires were used if conditions required, though in all cases, the primary control against the spread of fire was the proper judgment of fuel and weather conditions. Because the surrounding margins of meadows are relatively drier and more exposed to repeated fire damage, individual trees and bushes in these zones were often killed over time. These scarred and fire-killed trees and brush often caused flare-ups which meant additional fire kills and the gradual advance of grasslands. However, such flare-ups quickly dropped down and went out as they reached the moisture laden trees, shrubs and grasses of the forest.

It was admitted by a few informants that on rare occasions fires did escape. However, those fires which ran into the surrounding forest, as a result of sudden winds, a smoldering log flaming-up a few days later, or simply as a result of poor judgment were less destructive in spring than were summer lightning fires. With the simplest tools, they were also fairly easy to contain. Thus, on the occasions when spring fires went into surrounding vegetation they did little if any damage, since they usually remained on the ground rather than being carried into the canopy, and often burned themselves out, or were put out, in relatively short time.¹⁶

Slope and daily changes in air currents were used as additional controls in the foothills of the Rocky Mountains. Mountain meadows were burned in late afternoon, when air currents normally move downhill. In those instances a controlled fire was set at the top or head of the meadow and allowed to burn down slope to the lower, wetter portions.

We'd always wait until late afternoon and the fire was set at the upper end (of the meadow). It would burn down to the low, damp places where the really wet grasses grow. That's the way we burned mountain meadows. Gee, you have to know the wind; you have to know how to use it (Cree-Metis, 76, Grande Cache area).

Yes, lots of times. I used to burn, meadows and brush. Meadows are new grass that seeks to come out. You see, you burn over the meadows and after that good grass; (if) you don't burn, the grass just die out. But you burn it clean and everything coming up good You burn in early spring (while) the bushes still got a lot of snow on them. Fire don't go no place....Still snow under the trees; burn grass but the trees are still okay. Where we kept horses, where they like to graze, it was good for them (Cree-Metis, 84, Beaverlodge area).

The removal of dead plant material both "unlocked" and helped recycle the nutrients, and because of the cleared, blackened surface, resulted in a more rapid warming of the soil. The result was an earlier growth of grasses, and a longer growing season. With varying degrees of insight (affected, I am sure, by the age of some, and the problems involved with my using translators) all informants were aware of this set of relationships: spring fires meant early growth and a longer period of growth in the weeks to follow.

An important reason for burning all meadows was the maintenance of browse and grazing areas for game and stock animals. The early growth of grasses attracted game to these spring burned meadows. Also, burned areas made hunting much easier. For example, moose will sometimes come to burns within days or even hours after a fire. They are attracted to recent burns to rest in the sun and even roll in the ash. Further, moose were observed eating the burned leaves and twigs to, as one informant described it, get the "salt". This comment apparently correlates with physiological and behavioural knowledge of moose. Though scientific research is limited on this, it appears related to shortages of sodium in moose diets, specifically those moose dependent upon the forage of northern forests (Jordan et al 1973). Whatever the underlying chemical-physiological factors, Indian informants maintained that these behaviours of moose were important in terms of hunting during the days following a fire--this occurring after any fire at any time of the year.

Also, regularly burned meadows were preferred for hunting because there is a much more distinct line between grass and trees. The edges of unburned meadows are characterized by a fairly wide margin of advancing trees and shrubs, which makes game harder to see, and approach within range. Meadows near settled communities were less productive of game than those farther away, since animals tended to avoid the most frequently visited and hunted areas.

Consequently, larger numbers of small meadows at greater distances from settlement areas were desirable.

They used to burn places where they think it was very useful. Like, for instance, the places where the horses used to winter in order to have plenty of good feed for them on grass; and then where there's lakes, around lakes, where there's muskrats, so that they could always have real fresh roots. (Muskrats) live on grass roots mostly--to keep them nice and fresh. If they don't (burn) the roots will spoil and rot you know, and then they'll die off every so many years. Places where there's moose and where the moose usually like to roam around. They burn the brushes there so that they'll have good green leaves and things to live on in summer. And, places where the Indians live close to...they'll be brushes like you see around, poplars growing in one place, eh. That's where they used to burn (Beaver woman, 69, High Level area).

Esthetics of the land were deemed improved by burning; informants mentioned that the country "looked nicer" and that it "was good to have lots of meadows." Not only did controlled burning keep back trees and brush and reduce the hazard of natural fire, it also facilitated cross country travel, both on foot and on horseback.

Though horses were first brought to Alberta during the eighteenth century, their numbers did not become significant until the early part of this century in the northernmost part of the province. Cattle were also introduced at that time, and some stock were maintained by Indian families. As prime land was taken over for farming, and forest encroached on secondary grasslands, numbers of both cattle and horses varied. Thus, the introduction of stock animals, particularly horses, may have brought about some change in the frequency and size of local meadows maintained by periodic fires.

Meadows that were burned to provide a better, more abundant, and earlier growth of forage for stock animals were referred to as "hay meadows." After the turn of the century, with the introduction of horse drawn mowers and dump rakes, their grasses were cut and the hay kept as winter fodder. In a few of the communities visited, these mowers and rakes are still used, and haying remains an important family activity for those who keep horses. Other hay meadows were not cut, and horses were, and still are, left to roam for most of their feed.

It is certainly not the case, as one forester suggested to me, that Indian burning of meadows must have begun at that

time. Knowledge of the Peace River district and of Prairie Indian practice in the south (Stewart, 1955d) preclude the possibility that Indians were merely instructed in practices of burning by White settlers. White burning practices, such as summer fires to clear land for farming, uncontrolled burning of saw milling residues, fires set by prospectors, and fires caused by railways were often the very ones which resulted in the worst fire problems of the late 19th century. It was these practices, more than Indian use of controlled burning, which led governments to outlaw all burning after 1910.

Until the mid-eighteenth century bison ranged throughout much of the boreal forest, as far north as Great Slave Lake and the Mackenzie River in the Northwest Territories. Indians were known to have regularly burned prairie grasslands to the south (Arthur 1975:10-30), and it seems unlikely that either the Athapaskans or later Algonkians would have overlooked the possibilities of providing and maintaining better habitat for woodland buffalo.

According to one informant from the area, until quite recently, spring fires were set in meadows on the margins of Wood Buffalo Park in northeastern Alberta to make better "buffalo grass."¹⁷ This burning was done outside park boundaries, so that animals would be attracted to these areas and legally hunted. In addition to the buffalo grass areas of northeast Alberta, hay meadows and parklands of the Peace River basin were extensively burned to maintain alternate habitat for buffalo and other game animals.

Observed Vegetational Changes

All informants commented on the changes in vegetation from earlier times. Without exception, the loss of meadows to the encroachment of brush and trees was viewed negatively, for all the reasons previously cited. Over and over again informants pointed out areas of brush and scrub forest that were once meadows maintained by annual spring burning. Bird (1961), for the prairie provinces, and Bailey & Wroe (1974) for Alberta in particular, have documented the general extension of the southern boreal forest limits into what was formerly prairie grassland. Within the boreal forest itself, land which is now in brush and aspen-spruce successions show dramatically on Forest Service "forest cover maps" as areas that once constituted a mosaic of intervening grassland.

A side effect of Indian burning was that in maintaining open grasslands, it was made that much easier for pioneer farmers to convert land for agricultural purposes. In large measure the Indians provided a preadaptation for pioneer farming within northern Alberta, the intrusions of which ultimately brought an end to their own hunting-trapping adaptation in some areas.

I was eleven years old (in 1912) when I came here from England with my sister, brother, and mother. My father was already here pioneer farming....In those days you could see right to the lake (one mile distant) and the island out there—just a few trees on it then, and lots of deer to be hunted there, but not now....I remember being scared that first spring when the Indians set fires in all the meadows. There were smokes everywhere. That's the way they kept this country open, you know. Now, except where we actually farm, the trees and brush have taken over most of what was grassland. My father said that we'd had a terrible hard time pioneering if the country hadn't already been open (White, 73, Lesser Slave Lake Area).

Sloughs and Stream Courses

Traplines generally follow the meanders of creeks and sloughs, and vegetation there provides a suitable habitat for selected fur-bearing species and virtually all game animals. Fires were used to further enhance the attraction of these sloughs. For example, fires checked the advance of aspen-birch stands, increasing the subsequent abundance and availability of beaver food. The burning of grasses and reeds around lakes and ponds benefit muskrats, by stimulating new root growth. Snowshoe hares frequent recently burned and fire-maintained areas to feed on willow sprouts and shoots of aspen, spruce and pine. As with meadows, such areas support large numbers of mice and voles, an important source of food for the predatory fur-bearing species of the adjacent forest area, especially marten and fisher. An abundance of these smaller rodents, in turn, affects the populations of lynx, coyote, wolf, and fox. Of all the boreal forest species, only the beaver approximates the environmental impact made by man, and even the beaver was assisted in its own pattern of manipulation, by the practice of Indian burning, which maintained local stands of willow, aspen and birch.

In times past, people knew where to trap animals—mink, weasel, marten, lynx, lots of kinds. It makes a lot of difference for the trapper if an area was once burned. As for the beaver, it takes a while before they move into an area that was burned; about four years after the burn. The reasons why it takes that long for the beaver to come to those places is that the aspen don't grow as fast. People know where to hunt. Our people have a name for those burned places in the forest called go-ley-dey. They tell one another about those

places and when to hunt there (Slavey, 69, Meander River area).

For the Indians, then, the sloughs provided both food and furs for trading. Consequently, the maintenance of this pioneer stage of plant succession was fundamentally important to the Indians' overall strategy of adaptation.

Trappers burned when they were on their way home from spring hunting. At that time of year it was safe and they burned because it made it better for them in the winter with more animals to hunt and trap for. But it is years ago they did that. Nowadays you can't burn on the trapline because it's against the law, and it's not so good as before (Slavey, 73, Meander River area).

The conditions under which sloughs were annually burned were effectively the same as those for meadows, the main difference being one of scale. Fewer (usually one or two) individuals were involved in the burning of much smaller areas. All such areas were burned in the spring; there were no exceptions to this. As trappers returned to the main settlements at the end of the trapping season, the grasses of the sloughs along the lines were set afire. In the smaller drainage, this amounted to a string of small fires as the trappers worked their way out to the larger streams or rivers. As trails joined with those of other trappers, the first man into unburned areas was expected to burn as he went. This was partially to facilitate the travel of others, but also to take advantage of burning conditions if they were appropriate then.

Like meadows, the grasses of sloughs and stream basins were burned while surrounding forests were still damp. In some instances though, they might be too damp and patchy with snow to be adequately burned at the time trappers returned home. When this occurred, smoldering log fires were left burning, incendiaries which would flame up when grasses were sufficiently dry but would expire while the forest remained wet. The custom of leaving campfires to burn in the spring was a marked contrast to the care with which they were extinguished during the summer.

When we'd come off trapline it might be too wet to burn the sloughs or creeks (creekbeds). So we'd just build a big campfire and leave it. Maybe couple weeks later even, when the grass is really dry, the grasses would all get burned up, but the fire wouldn't go anywhere because it was still damp in the bush....We didn't worry about campfires in the spring-time; but you had to be careful during the

summer cause you could start a helluva big fire (Cree, 76, Wabasca Lakes area).

With the spring hunting of muskrats trappers returned and fired sloughs. The forests surrounding the grassy swales and sloughs of a trapline were the primary habitats for such important fur-bearing species as marten, fisher, red squirrel and others. Because of this, care was always taken so as not to burn mature forest stands.

Lots of animals that live in the forest come to the meadows and sloughs to hunt. Marten, like, they live in the woods but they hunt lots in the grassy places—specially mice. So you don't want to burn the woods, just the sloughs and meadows. Now, course, we don't burn any of it (Slavey, 58, northwestern Alberta).

The essence of what ecologists call "food chains" was well understood by all informants. The understanding of diverse habitat requirements, and plant-herbivore-predator relationships were intrinsic to the Indian technology of burning.

Burning sloughs was also good for foxes. When you get thick grass all bent over it's hard for the fox to dig down to get the mice, and the foxes are really hungry that time of year (spring). When you burn it off, well sure you kill lots of mice—maybe hundreds; you can hear them in the fire, but they come back by the thousands. Then it's easy for the fox to get the mice and we get lots of foxes too (Slavey, 60, northwestern Alberta).

Do you know that wolves hunt mice? I saw this one (wolf). Real funny. He was jump'n up and down, crazy like. He was catch'n mice. It was so funny I forgot to shoot'm. I laughed so loud he saw me and run away. He was catch'n mice long a creek we'd burned that year (Slavey, 60, northwestern Alberta).

The same considerations of frequency, seasonality, time of day, wind, weather, and fuels were used in burning both slough and meadow. However, meadow maintenance was seen more as a form of "public domain" with community interests and community responsibilities involved. The burning of sloughs, like the traplines, were primarily matters of individual or family concern.¹⁸

In all instances of prescribed burning there were pronounced concerns about the possible spread of fire to

surrounding vegetational areas, though not in the sense of forest fires, viewed as essentially destructive. Natural fires were a factor to which Indians had to adjust. Some natural fires, though not most, were highly disruptive; all were potentially dangerous. Natural fires tended to occur at the wrong time of year, usually summer, under highly flammable fuel conditions, and sometimes had the immediate adverse effects of setting back plant succession much further than desired.

However, natural fires are not simply destructive. Informants told of areas of natural fire succession that were, and still are, visited to collect berries and hunt the animals frequently found there. Though natural fires delay and temporarily disrupt plant succession patterns, the more general effects are no different than those that occur as a result of controlled burning.

Summer fires are really dangerous. There was a big one started over in B.C. and burned right through to those blue hills. It ruined some places on my dad's trapline. There were lots of deer and moose after that. Those (kinds of) places are good for hunting, just like where he says you burn along your trapline only sometimes they are really big and there are some kinds of animals (i.e. the prime fur-bearing species) that you don't see there 'til it grows back trees (Slavey, 46, during translation for his father, 71, Hay Lakes area).

The important adaptive difference for human populations is that occurrences of natural fires are unpredictable and can, in the short run, cause considerable widespread, though temporary destruction. In a region of relative scarcity, the destruction of standing plant communities over hundreds or thousands of hectares carried potential disruption for local populations of herbivores, carnivores, and human hunter-gatherers. Man-made fires, on the other hand, were predictable, almost immediately productive, and provided some measure of protection against the disruptions of natural fires.

Making a Meadow

In my earlier studies on California Indians (Lewis 1973), it was suggested that meadows in the coastal forests of northern California were man-made rather than natural openings, since under natural conditions these meadows rapidly reverted to forest cover. However, no information existed in historical or ethnographic records of California Indians concerning the origin of such meadows. And, though it can be safely assumed that some boreal forest meadows were man-made, it was not expected that this information could be

readily obtained.

Originally, two individuals volunteered the information that, under specified conditions, forested areas had been burned in order to create a meadow. Subsequently, other informants also acknowledged this practice, but altogether, less than one-fourth of those interviewed confirmed its use.¹⁹ It is impossible from this research to determine the regularity in which meadows were created, or whether it was done in only certain sections of the boreal forest. An educated guess would be that it was carried out infrequently, and was not a common or especially necessary activity, since so many meadows already existed. The aim was simply to change a habitat of trees to one of grasses; the reasons mentioned included the need for horse pasturage, the opening up of sloughs, the establishment of seasonal campsite areas, the attraction of greater numbers of game. One informant said that it was done when traplines were relocated or new hunting areas were sought.

Burning took place during the late spring or early summer when trees were sufficiently dry to burn, but not yet so dangerous as during the height of summer. Along streams or sloughs, winds were employed to direct the fire toward the stream, taking advantage of natural firebreaks.

Within muskeg areas fires would be ignited among trees around a bog or shallow pond, using the wind to carry flames towards the water. The selection of an appropriate area was ultimately determined by the plant cover and kinds of soil supporting that vegetation in a selected site. Informants noted that areas of aspen and white spruce could be converted to meadow and that this change related specifically to the soils found there. The soils underlying a jackpine stand were sandy and resulted in a much poorer cover of grass. Soils supporting a black spruce forest were poorer still. However, in some instances it was possible to burn off black spruce and mosses which grew on water-logged soils and, as a result of this removal, the soils would dry sufficiently to support a local invasion or regeneration of grasses, willows and aspen.

You could make a little grassy area some places in the muskeg. When you were on trapline in the winter you go (back) there and look for moose, cause they find those places and they like 'em. It gotta be the right kind of place or the grass and brushes don't grow. The little white mosses grow there. You can burn places like that but sometimes the fire burns more, more than you want, but it's not so dangerous in the muskeg like other places. Still, you gotta watch out (Cree-Metis, 74, Lac La Biche area).

The "right kinds" of soil were described as dark or peaty. A check of the soil itself was not needed in an established stand of aspen or white spruce, but it was examined in areas of drier muskeg where it seemed possible and desirable to develop a small meadow. A part of this examination involved looking for hummocks of peat and noting whether any of the "white mosses", which could also be found in white spruce forests, grew there. These areas, according to informants, were sometimes found at the edges of some shallow ponds. Two examples described to me were along existing traplines and regular hunting routes. As new traplines were established or older hunting areas abandoned this form of burning facilitated the exploitation of new trapping-hunting resource areas. On speculation, these meadows were probably remade over various periods of time as regions were used, temporarily abandoned and later reclaimed. Feit (1973) mentions a similar "rotational use of territories" in describing the Waswanapi Cree of eastern Canada, though he makes reference only to the use of naturally burned areas and does not mention man-made firing.

Deadfall-Windfall Forests

The practice of burning off aged and diseased forest was, in many respects, inseparable from that of clearing for new meadows. Six informants mentioned burning deadfall forests where, because of age, disease and bug kill, trees were beginning to die off and topple. Such forests no longer support many useful plants or animals, and they carry a great danger of fire being ignited by lightning during the heat of the summer, with the development of destructive crownfires a possibility.

Part of the rationale given for burning such areas was that "they would burn anyway" because lightning is "attracted" to deadfall forests. In this respect the Indians may have been right for the wrong reasons. It has been suggested to me²⁰ that there is no particular reason why lightning should hit deadfall forests with greater frequency than would be the case for live forest stands. However, the likelihood of fire ignition occurring is significantly greater in deadfall because of the greater flammability of fuels. In addition to Indian concerns about safety, deadfall forests were seen as undesirable in that, except for some game birds such as grouse, they were all but devoid of animals, and, therefore, not useful for hunting or trapping. Also, where windfall was extensive, the tangle of downed trees made travel all but impossible within the forest limits.

Because of the wider, adverse effects of summer fires, it was considered best to burn these areas under controlled conditions. Though burning took place in the spring, it was not without dangers either; one informant noted, "We some-

times got a pretty hot fire." Nonetheless, the conditions for controlled burning were much better than relying upon natural fire.

If the area was to be maintained as grassland, subsequent burning would take place each spring. If it was to return to a forest succession, then the area would be burned for two or perhaps three years in a row. These second or third-year fires were set at appropriate times in spring to clear out the remaining trees and deadwood on the ground.

When you burn the deadfall places it burns for a long time, not like the meadows—they burn out fast. Because there's all those dead trees. Maybe the next year you come back, burn it some more and then pretty soon it's all open and the moose really like those places (Cree, 79, Chipewyan Lake area).

Firewood

Another frequently mentioned reason for burning trees was to obtain firewood. Fresh cut wood is green and takes a long time to dry thoroughly, while partially burned wood is excellent, pre-dried fuel for stove or camp fire.²¹ Only the worst fires, such as those that occur during the heat of summer, completely consume the heart wood, and even trees killed by moderately hot fires leave large amounts of unburned wood in trunks and limbs.

Here again, burning took place in the spring. The trees preferred were aspen, though burnt willows were regularly used for kindling. If possible, enough wood was burned to last through the summer and winter months. Much wood was to be found at the edge of meadows where repeated spring burns would scar and subsequently kill a few trees. Thus, portions of meadows progressively expanded until spring campsites were subsequently abandoned and the forest advanced again.

Sometimes whole stands of isolated trees and brush were fire-killed. This was always done later in the spring when the surrounding bush was dry enough to carry the fire throughout all, or a large portion of, the stand. These fires were controlled simply by selecting areas of brush and trees within a meadow which had been burned several weeks earlier. With the adjacent ground cover burned clear, they were able to burn the isolated stand sufficiently hard to fire-kill much of the brush and trees while avoiding the spread of fire to nearby cover. This follow-up burning of plant growth within the confines of previously fired meadows was also applied to the reed and marsh grass fringes of ponds and lakes found within larger meadows. This was done, of course, to maintain the preferred habitat of muskrat and water-fowl.

Where communities settled for long periods of time, especially near trading posts, the supply of firewood was a problem in that people had to go further and further afield to find suitable stands of trees. Along traplines and while hunting and collecting in the bush this situation presented no particular difficulty. However, if insufficient amounts of firewood were accessible for the winter months, or if new winter campsites were established, it sometimes became necessary to make additional burns in the late fall. Since fall burning was considered much more dangerous, burning for firewood was, if at all possible, accomplished in the spring.

Look at that wood (recently cut, green aspen). It don't burn worth a damn. Used to be plenty of firewood. (Spring) fires would always kill some trees around that meadow. And on trapline, same thing. You had good, dry wood, lots of firewood--willows, aspen. My grandson cut this wood for me last summer (one year earlier) and it don't burn good now (Beaver, 86, Beaverlodge area).

Improving Settlement Areas and Campsites

Ground cover was annually burned in and about settlements. This was done to both "cleanup" and help fireproof communities. As discussed, the fringe areas of a settlement also provided supplies of firewood as the annual growth of grass and small shrubs was burned each spring. In the event of a forest fire during the heat of summer these open areas reduced the most destructive effects of a major conflagration. However, even with hazards locally reduced, the dangers of a running forest fire were still great. Vivid descriptions were given how people once had to take flight before the largest fires or seek shelter in the open water of a lake.

Existing fire hazards produced by an ever-encroaching forest are fully appreciated today. The reduction of fire hazards involved more than just the burning of ground litter around settlements; informants clearly understood that the effects of all burning constituted a general reduction in hazards for forest systems as a whole. The fire clearing of settlements and campsites was only one special, immediate case of protection against fire.

What is that name? Maskuta? Muskotaw! Yea, that's a prairie like place. There used to be lots of those places around here. Nobody built their house in the woods like they do now. If we get a forest fire now it could be really be bad. All the houses would get burned up. It's a lot safer if you got open

places...you just set your teepee up there
(Cree, 78, Trout Lake area).

The historically recent practices of burning areas that were to be planted as household garden plots was related to the fire clearing of settlements. In criticizing the restrictions on burning, one informant noted that the small vegetable gardens in and about the permanent settlements were no longer as productive as they were when the ground cover had been burned each year. Why garden crops were better when surface litter was burned was explained to me essentially as follows: the burned and blackened surface following fire resulted in a more rapid heating of the soil. This meant that seeds could be planted days or even weeks sooner than in an unburned plot, they grew more rapidly, and they ripened before the first frosts of autumn. In an area where frost-free periods are as brief as 80-100 days, this added inducement to earlier, more rapid growth is very important.

He says that he can't grow vegetable gardens now. When they used to burn (around the settlement) he could plant a lot earlier and then the frosts don't kill everything in the fall....You know, the old people really understand stuff like that, what they used to do in the old times (translation by younger Cree of 84 year old informant, Trout Lake area).

A stated concern during winter, when hunting or on traplines, was where to set campfires when unsure of the surface material beneath the snow. Campfires built over a thick carpet of mosses or peaty soils can ignite those materials, which could then smolder beneath the snow throughout the winter, and possibly emerge as a full-blown forest fire the following summer. Consequently, winter campfires were either set in areas where the underlying vegetation was known to be safe, or the snow was cleared to determine what lay underneath.

Making and Maintaining Trail

Much of the Indian trail network followed along areas maintained by fire: meadows, sloughs, and streams. In these areas willows would be burned along streamside trails in the spring while the forest understory was still wet or covered with snow. In the southern portion of the boreal forest trails through mixed wood stands of aspen, white spruce and jackpine presented no special problems, and animal trails became enlarged simply through continued human use.

In regions where trails passed through stands of black spruce, with their undercover of waterlogged lichens and

mosses, fire was apparently more important for trail maintenance. Trails were kept wide and exposed to sunlight, thus keeping the walking surfaces relatively dry. As elsewhere, by being burned in the early spring, fire seldom carried into the wetter, surrounding cover of plant material. Meadows, stream courses, and trails constituted a network of fire-maintained habitats, and this diversity of habitats made overland travel considerably easier during spring, summer and fall.

I had just started working for the Forest Service then (mid-1920's)....This (Cree) Indian crew had gone ahead of me--I was having trouble keeping up with'em--and when I come along the trail, all of a sudden, there was a fire right on the trail. Well, I put it out. Then I come on another, and then another! Well, o'course, I had a pretty good idea who was starting them fires. When I caught up with the crew they were having lunch and just starting another damn fire! What was I going to do, eh? I couldn't just arrest my crew, the first day on the goddamn job! I told them it was wrong and that we'd all get in a helluva lot of trouble if it was found out. Later, after I'd been up here a few years, I realized that those (trailside) fires weren't going to go anywhere. They only did it in the spring and the fire burned to the wetter stuff and went out...and that's the way they kept trails open through the muskeg areas (White, 70, Fort McMurray area).

Berry Patches

Initial inquiries provided me with no information about burning to improve berry patches. It was not until my third summer of interviewing that a female Slavey informant, a woman at least in her nineties, admitted that berry patches were sometimes fired. There seems to have been two reasons why so little information was obtained about this particular activity.

First of all, berries are found around the fringes of most open areas, whether man-made or naturally formed by stream beds or summer lightning fires. Consequently, the need for burning "berry patches" was not particularly pressing. However, as a few women noted, fires were at least occasionally used to specifically affect berry production.

The second consideration about such burning relates to the division of labour between men and women. Burning to affect hunting and trapping resource distributions was in all aspects a male activity, in which women played little or no

role. Subsequent interviews revealed that the burning of berry sticks and bushes was sometimes done, but since the berry patches were "woman's work" this type of burning also became woman's work.

I don't ever know about burning for berries. That was woman's work. They sometimes did that. It was good for strawberries; and raspberries when they got old. Not all berries, not saskatoons. Anyway, there were always berries round a meadow or places where there has been a (summer) forest fire, and those are good places to hunt bears (Slavey, 66, Meander River area).

Some berries produce larger amounts of fruit in the same year of a spring firing. This was said to be the case for strawberries and blueberries, for example. If the fire was moderate, raspberries also produced more fruit in the following summer, the general effect being that of thinning out old growth in the same way that last year's raspberry sticks are cut. However, if the fire was relatively intense, as was usually the case where heavier, dried fuels lay, at a meadow's edge, then raspberry sticks were heavily burned and fruit did not appear until the year after. Saskatoon berries, apparently, did not respond to frequent burning, these being adapted to the later periods of growth following a fire.

She says that burning is good for some berries but not others. It's good for raspberries and strawberries. If you burn those places hard you don't get berries for another year. But just a light burn and you get some growing good berry crops that summer (Translation of Slavey woman, approximately 95).

It was recognized by all informants that berries were the favoured food of bears. Consequently, both naturally burned and man-fired areas were good areas for hunting bears.

Marshes and Lakeshores

The marshy grasses and reeds found between water and forest are the habitats for both waterfowl and muskrat. About half of those interviewed emphasized the importance of spring burning for the maintenance and improvement of these shoreline habitats. In the absence of regular burning, rootgrowth of reeds became matted and died, and reduced the available feed for muskrat. The regular burning of shoreline habitats helped to provide new rootgrowth, and subsequently larger populations of muskrats, which were important to the Indians for both fur and meat.

Muskrats like to eat the grass roots, like the reeds that grow round a lake or pond. When you burn them the roots grow more and it makes it good for the muskrats. If it don't burn regular then it don't grow—it gets all choked up, dead stuff—and not so many muskrats (Cree-Metis, 77, Utikuma Lake area).

A concern of wildlife management groups today is the potential fire destruction of waterfowl habitats and nesting areas. When asked about this, informants patiently explained that burning always took place before nesting ever occurred, since they wanted more ducks and geese, not less. They were well aware that fires ignited later in the year were harmful to nesting birds and the plants upon which they fed, just as they were equally aware that early spring burning was beneficial to both the nesting and feeding activities of ducks and geese—a view supported by research on the ecology of fire in lake and marshland areas (Ward 1968).

We always burned just before all of the snow melted, before the ducks had started to nest. But we didn't burn after the ducks had nested; we knew when to burn and when not to burn. The spring fires made things good for the ducks, and it was good for all kinds of other animals too (Slavey, 73, Meander River area).

A lot of the burning was around the lakes, especially to make it better for the ducks. The ducks like the fresh roots that come in after a fire. They get, like, little potato-things, real sweet, that they like to eat. There's still lots of ducks around, but not like they were before....There was lots more of them then (Chipewyan, 77, Cold Lake area).

For those Indians who hunted one or more of the major northern nesting areas, duck meat was a very important resource. Even in contemporary times, the food derived from May to December when waterfowl were present in the area constituted a major source of protein. A study among the Slavey of Hay Lake Reserve showed that average consumption of duck meat per capita was .6 pounds per day during the duck season (MacAuley & Boag 1974).

Other Reasons and Places for Burning

One of the difficulties of documenting the reasons for burning was that informants seldom included all of what they perceived and understood to be involved. For instance, when asked why a meadow was burned, an informant might give one of several answers but, when pressed to comment on other consequences involved, additional "reasons" were forthcoming.

Some new information came out only as a passing remark, surfacing well into the interview process itself. Since the process was built as new information was gained, those first interviewed were not asked all of the questions that were asked of those later on.

There were, for instance, esthetic and religious considerations involved in burning, though how pervasive, and how important they were is impossible to say. Several individuals commented on how much less attractive the environment is now than when spring burning was practiced, and not surprisingly, esthetic values and environmental concerns were equated.

Because the research did not involve extended periods of time in any single community and because the subject of traditional religious beliefs is somewhat sensitive, no specific questions were asked about the perceived relationships between the uses of fire and religion. Questions about ritual observances, both personal and communal, were raised with some informants, but replies were consistently negative. In light of the fact that traditional religion was strongly associated with natural phenomena, there undoubtedly are religious beliefs related to practices of controlled burning. However, comments on religious beliefs were tangential at best.

Windfalls--where there's all dead trees--those aren't good places. Nothing lives there, nothing is any good. We set fire to those places in the spring. That way the fire makes the forest live again (Slavey, 68, Hay Lake area).

Fires were said to reduce concentrations of black flies and mosquitoes, as a consideration of burning around settlement areas. The overall impact and significance of this burning may be impossible to say, other than that insects are not found in such great concentration in open areas. In a more direct way the smoke-filled environment of a teepee helped protect against the worst infestations of mosquitoes and black flies. Even today though, domestic stock is highly susceptible to insect attacks, and punk fires of dried manure are still set so that horses may cluster directly over them to escape the virulence of flies and mosquitoes.

Several individuals commented that animals, both domestic and wild, were much healthier if they grazed areas that were frequently burned. For instance, where horses grazed it was considered good to burn; in the absence of burning there were "things in the grass, things that come from their own shit" which could make them sick. One informant, a former resident of the Rocky Mountains, said that mountain sheep were similarly affected. In the absence of regular burning,

there was less feed available. When sheep regrazed areas, the diseases carried by only one or two animals would be quickly spread throughout local populations.

See, mountain sheep aren't like domestic sheep. Mountain sheep prefer only the tips of green grass; they don't like to graze an area more than once. When the burning stopped there were fewer grassy areas than before, so the sheep came back again and again....Maybe one sick animal, like one with lung worm, would pass its sickness on to all the others. When we used to burn there was always plenty of fresh grass and they didn't have to do that (i.e. graze areas twice) (Cree-Metis, 76, Grande Cache area).

He says even then the Indians used to try and keep their animals like horses, and even some of them had cattle, healthy. When you burn the hay meadows there's really nice clean fresh grass for them...and that's the first thing an animal looks for, it's their tonic Some spots, if you leave it unburnt, it's always damp and there's old hay. If you take that hay and look inside it there's all kinds of insects in there and that's what makes the animals sick...I think it's what the doctors today call swamp fever or something (Translation for Slavey, 73, High Level area).

Finally, a few individuals stated that spring burning was exciting, that it was "fun." People watched fires, not only for safety reasons but because these were interesting events to see. Sometimes fires were initiated at times when food might be scarce; winter was at an end, and new growth was about to begin. Where burning required lengthy considerations of both the goals and conditions of firing, both long and short term, it required virtually no effort other than moving to, and setting the fire, in the appropriate place. From that point, individuals simply admired and enjoyed their own handiwork.

Signal Fires

"Signal fires" seem to have been a preoccupation of explorers and settlers. Early documents on western Canada frequently mention this as an Indian practice. However, only one informant mentioned the use of signal fires, and the fact that he was a former resident of the Rocky Mountain front range would suggest that terrain was an important consideration. In his example, individual, isolated trees would be set afire as people returned from long trips. These were

always set on high ground where trails crested along ridges or over passes, where they would be visible for several miles. But this was a rare occasion, always arranged well in advance.

Where the trail came into the valley it was up on a high, rocky ledge. At that place we were still an hour ride from home and if we wanted to let someone know that we were coming we'd pick out an isolated tree along the ledge and then set it off. The greener the tree the better cause you wanted lots of smoke....No, it wasn't dangerous; just one, small green tree and nothing around but rock. We didn't burn the whole forest down just to let someone know that we were home. We weren't crazy, you know (Cree-Metis, 76, Grande Cache area).

In the flat boreal forest regions no examples were found of signal fires having been used. It is possible that the flatness of the country and the continuity of vegetational cover prevented such practices. In any event, "signal fires" seem to have been more of an afterthought of White observers than an ongoing practice of Indians.

From there you could see the (south) slopes of the Caribous (Caribou Mountains) and you could see the smokes, a string of fires, that the Indian trappers were setting as they came in the spring. You knew they were on their way home then; it was a grand sight (Oblate priest, 76, Fort Vermilion area).

The Reintroduction of Burning

As a point for discussion informants were frequently asked to compare existing cover of vegetation with the past. Without exception it was stated that the country was previously much more open than is now the case. Areas that were once open grasslands or parklands and areas with more mosaic habitats are now dominated by brush and trees.

I'm old now but when I was a young man the Meander River area was like a prairie. But it's all grown up now; lots of bush and lots of trees where there used to be grass. The airport is three miles from Meander and from here to there it used to be all open grasslands. But not now (Slavey, 73, Meander River area).

Discussions sometimes led to their views about the desirability of the government's reintroduction of controlled

burning as a forest management practice. They all felt that this would be beneficial.

To start spring burning again would be good for people because it would help a lot; like it was a long time ago. It would be easier for people to trap and hunt around the burn, along their traplines. It is kind of hard for people to burn now days. The way things are now it would be hard to burn. It would be better to burn again because it would make things different for our people (Slavey, 66, Meander River area).

However, it was also recognized that "things" are no longer the same. Because of pronounced increases in amounts of brush and trees, the environment has been significantly changed—and in their view, changed negatively—with the result that all burning, spring, summer or fall is today potentially more dangerous. The elders were also well aware that activities such as logging, drilling, recreation and farming would necessarily involve changes in burning practices. They have grown up with these developments while remembering the traditions of spring burning. Whatever their feelings about these intrusions and enforced changes, they well understand that burning practices would require adjustment, as have other aspects of their lives, to these pronounced alterations in the natural and social environments.

Sure, it would be good to burn meadows, traplines again. But it would be hard to do the same thing again. I mean, it's not like it was then. There's oilfields all over now. It would take a long time to make the country like it was before we stopped burning...maybe fifty years to get the country back (to what it was). It would take a lot of work (Slavey, 73, High Level area).

Conclusion

A few years back a fellow anthropologist asked me whether Indian informants thought about and understood the environmental consequences of their burning. Was it something they "just did", or did they actually think about the broader implications of their actions? Coming from an anthropologist such a question is somewhat disturbing, not because anthropologists do not understand the highly variable impact of fire on environments but, because it is assumed that foragers would not understand the cause and effect relationships of such an environmentally important activity.

Besides the fact that anthropologists have given virtually no thought to indigenous customs of burning, there is

the tendency among us to view such behaviours as simply based upon tradition. We tend to see them as activities carried on because of some cultural, social, economic, techno-environmental, or other imperative, which directs or even determines what people must do. This view implies that hunters are essentially unaware of the broad ecological relationships by which we characterize a natural environment. This is coupled with our image of foragers as passive respondents in environmental dynamics.

With respect to traditional uses of fire, the Indians of northern Alberta exhibited a clear understanding of both what was happening as well as why things happened. They exhibited full understandings of systemic, relational effects of burning in their discussions of both the usefulness of burning and, in contrast, the environmental problems of contemporary practices of fire exclusion. In this respect, they are well aware of the highly variable ecological relationships both resulting from natural and man-made fires.

Contemporary studies on the ecology of fire in the Canadian boreal forest are based upon 15-20 years of observation and involve relatively few scientists for selected habitat types (Kelsall et al 1977:8). A reasonably convincing argument can be made that the Indian technology of burning is, or at least was at one time, well ahead of our own. Indian burning traditions were spread throughout the region in the greatest diversity of fire influenced environments. Their practices were noted by the earliest explorers. While we can never know precisely when and how such traditions began in Alberta, it is probable that they date back to the northern movement of Paleo-Indians following the glacial retreat of approximately 8,500 years ago.

Though the practices are of great antiquity, Indian burning technology was dynamic. Since the uses of fire in northern Alberta were adapted to specific resources in several habitat types, the overall technology was necessarily variable. Particular conditions of local abundance and the regional distribution of resources, necessitated constant re-emphasis and change to meet perceived needs in designated environments.

This view of a dynamic variability is supported by our knowledge of aboriginal burning in other regions for a variety of resources and range of microenvironmental types (Arthur 1975; Day 1953; Hallam 1975; Haynes 1978a, 1978b; Lewis 1973). Burning practices were adjusted to accommodate depletions, additions, or re-emphasis in the relative abundance and importance of those resources. In historically recent times in northernmost Alberta such changes were exemplified by the increase in importance of beaver and moose in the 19th Century, the relative decline in importance of caribou, the disappearance of woodland buffalo, the intro-

duction of horses in the first part of this century, competition from White fur trappers, and the early, though not initially effective, suppression of burning by government authorities.

The boreal forest, with its variety of microenvironments and resources, simply was not ignored or treated indifferently in burning. An unplanned or indifferent approach towards the uses of fire would simply have increased the kinds of disruptions brought about by natural conflagration, effectively resulting in the kind of situation that now exists in many wilderness areas where fire regimes derive from lightning storms, human carelessness, and pyromania. The bands of subsistence hunters and gatherers once understood, as some of the older Native people still understand, the relationships of local abundance and regional diversity to fire. This, in modern terms, is called the ecology of fire.

In popular North American usage, the word ecology has come to mean something other than strictly the study of the relationships between organisms and their environments—"the ecology" being synonymous with environment, and "ecology now" with conservation. Despite the dramatic growth and recognition of the field of ecology, traditional thought about the environment has not substantially changed, except for a greater public awareness of ecological problems: the pollution of rivers, endangered species, clean air, the energy crisis, the ozone shield, etc. People still tend to see only simple cause-effect relationships rather than the complex, multi-variable system of affect-and-counter-affect. Thus, popular views of nature are still not, in essence, ecological.

Systemic perspectives of the environment, including such concepts as econiche, community, ecosystem, biome, and succession, are fundamental to ecological understanding. It is this systems approach which so clearly distinguishes ecological from non-ecological studies of the environment.

Ecology...is the study of systems at a level in which individuals or whole organisms may be considered elements of interaction, either among themselves, or with a loosely organized environmental matrix (Margalef 1968:4).

Though not developed as a major point in this study, I think that the evidence shows that the Indians of northern Alberta possessed a complex understanding of the multiple role of fire in local environments, an understanding which was clearly systemic. Their view of boreal forest dynamics is truly ecological, however metaphorical, in its systemic ramifications.

The Indian perspectives were those of hunters, trappers and gatherers, human populations concerned with both the overall mozaic and the particular microenvironments that make-up a boreal forest. It is this broad, systemic viewpoint which perhaps provides the most important insight for us: the perception of distinct microhabitats of plants and animals, used variously for human needs, involving complex internal and external relationships, which simultaneously distinguish and relate such communities. While these communities are amenable to manipulation, they are necessarily understood and carefully managed in terms of their multiple internal and external relationships. This is not a cryptic, prescient view of "primitive ecologists"; it is a practical, time-tested understanding by humans who had come to know and successfully manipulate boreal forest systems for practical purposes.²²

Finally, in addition to illustrating the knowledge and uses of environmental factors in a boreal forest, this publication and the few other studies on aboriginal fire practices, raise questions regarding the whole amalgam of anthropological inference-cum-theory relating to the environmental impact of hunters and gatherers. Anthropology must seriously re-examine its ideas about the assumed passive role of foragers, the shifts involved from using fire for hunting-gathering to its use in swidden farming, and about the more simplistic evolutionary views of technical and environmental "efficiency."

Despite the fact that Omer C. Stewart wrote about Indian burning practices more than twenty-five years ago, our research into the ecology of human use of fire is still preliminary. Stewart, of course, did not have the well researched ecological studies and generalizations on fire that are now available to anthropologists. There are, however, still areas of the world, such as parts of Africa, Latin America, Oceania and Asia, where indigenous people continue to manipulate environmental resources through appropriate fire technologies. Unfortunately, most governments have thoroughly accepted the 20th Century view, propagated in Europe and North America, that fire is essentially destructive. Consequently, the practices of burning by huntergatherers, pastoralists, and swidden farmers are under great pressure, as in most cases are their nomadic or semi-nomadic styles of life. In terms of the significance which anthropological studies can have for both endangered societies and disrupted environments, few studies would seem more important than our understanding of these complex, socially and environmentally important situations.

Man has learned a great deal about the particular ecological effects of fire in selected habitats, especially those in North America, Australia and Europe. Elsewhere in the world we have relatively little or, in most cases, no

knowledge of the ecology of either natural or man-made fires. Where anthropologists have most often borrowed ecological perspectives and conclusions from the biological sciences, here is an instance where an important contribution can be made to other disciplines, as well as to our own, by recording the indigenous beliefs and practices of resource management using controlled burning. If the kind of information we now have of the indigenous practices of hunter-gatherers are indicative, we may gain and share important new insights into the ecology and technology of fire.

Although ecology may be treated as a science, its greater and overriding wisdom is universal (Shepard 1969:4-5).

Sloughs, where there's rats, muskrats, that's where they used to burn. And where there's heavy brush, you know, like a windfall and things like that. All the young trees would grow (and) attract animals like moose and things. Where there is timber and moss they don't burn (because) the fire lasts and lasts. And, furthermore, the fur-bearing animals like marten and mink and lynx, that's where they mostly stay in wintertime so they don't want to destroy that. They must be very wise, eh? Those people? That time? (Beaver woman, 69, High Level area).

In some ways and for certain purposes we assert that the recording of cultural practices is important. When such practices or the memory of such practices, as is the case here, are vanishing, a level of urgency is added to our work. However, the reason for preserving this knowledge is not only that it represented a disappearing part of Indian culture, or was culturally unique. It's fundamental significance is rather its commonality to both age-old knowledge and modern science.

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NOTES

1. Carl Sauer (1975) has discussed the broader impact of fire on the North American plains, but his interpretations involve neither new data about burning nor ecological evaluations of historical or ethnographic sources. A more important consideration of the role of fire in the northern prairies is found in Arthur's (1975:10-30) recent study of bison hunting. The much earlier work by Day (1953) on Indians of the northeastern United States is an especially important study for understanding the ethnohistory and ecology of that region. Other recent publications on the subject of burning include those of Omer C. Stewart (1951 etc.), Sylvia S. Hallam (1975), Rhys Jones (1969, 1975, 1980) and my own (1972, 1973, 1977, 1980, 1982).
2. Only a limited number of prehistorians have hypothesized environmental disruptions by hunter-gatherers and the evidence has been necessarily circumstantial. A few of these have suggested the direct control of animal species (Higgs & Jarman 1969; Jarman 1969, 1971, 1974; Mellars 1976; Zeuner 1963); a larger number have at least suggested the potential significance of fire (see Hallam 1975: 1-8 for a summary of these references).
3. Taken from personal communication between Omer C. Smith and the author.
4. Given the fascination which the control and flow of energy has had for many writers of the "Michigan School", this lack of interest is perhaps paradoxical. Rappaport, for instance, makes only two very minor notations regarding the burning of swidden fields in his widely recognized study of "ritual-ecology" in New Guinea (1968:42,52). The possibility of measuring the B.T.U.'s involved in the transformation of plant communities, domesticated or otherwise, would seem to be of fundamental importance to understanding energy expenditures.
5. Traditional burning practices used in northern Alberta appear to be common to similarly forested regions of eastern Canada (Thompson & Smith 1971).
6. Much of the work is summarized and referenced annually in Proceedings, Tall Timbers Fire Ecology Conference. A summary of information can also be found in Kozlowski and Ahlgren (1974). Additional studies on the roles of natural fire are available in a variety of natural science publications for habitat types ranging from tropical forests to sub-arctic tundra.
7. One of the paradoxes of modern fire exclusion and over-protection practices is that those areas most protected

become the most susceptible, and dangerous for fires. Numerous small fires create both diversity and protection against the worst ravages of fire storms which devastate more uniform climax forests.

8. Some of these include: (Bliss & Wein 1972; Heinselman 1981; Jones 1945; Kayll 1968; Kelsall et al. 1977; La Roi 1967; Lutz 1956; Rowe 1970; Slaughter et al. 1971; and others).

9. Kelsall, Telfer and Wright (1977) have summarized the more general, accepted views of the direct and indirect effect of fires on plants and animals in northern forests. For more detailed discussions, as well as differences in points of view, the reader should consult the original sources listed therein.

10. Ferguson, Theresa A. 1979. Productivity and predictability of resource field: aboriginal controlled burning in the boreal forest. M.A. Thesis, Department of Anthropology, University of Alberta, x, 145p., ill.

11. In those cases where translators were used, about one-third of the informants, I was much less successful in evoking information than where the informant and I both spoke English. I do not, unfortunately, speak Cree or one of the Athapaskan languages, and the use of translators can seriously inhibit a desired dialogue. So, not surprisingly, the very best informants were individuals who spoke either good or very good English.

12. I have learned that at least nine of those interviewed have since died.

13. When asked if they ever burned to drive animals, informants were unanimous in their disbelief that this practice ever happened, at least not in the boreal forest. Not only would it simply not work, but the results of a running fire, which one would set in the summer would obviously do long-term damage to plant and animal successions.

14. In this respect, foresters, who have to deal regularly, both with suppression of fire and controlled burning, will better appreciate what was involved than will anthropologists who have had little or no experience with vagaries of fire behaviour.

15. According to Peter Murphy, Department of Forest Science, University of Alberta, among contemporary advocates of prescribed burning in boreal forests, a majority argue for spring burning and a minority for late fall burns.

16. In late May of 1968 a lightning fire, involving intense

crowning, burned a total of 150,000 acres south of Lesser Slave Lake in central Alberta. This and other fires at that time were considered unusual; the dangerous burning conditions were, in part, attributed to an extended winter resulting in the foliage being deprived of water still "locked up" in the soil. Undoubtedly, such conditions had existed before, but informants insisted that burning would not take place when such a danger developed.

17. It has been suggested to me by Edwin Telfer of the Canadian Wildlife Service, that this term refers to certain species of sedge, especially Cardex atherodes, found among the margins of wetter meadows or bogs and that these constitute an important source of winter and spring forage for bison.

18. At this point, I have not obtained sufficient information to comment adequately about whether or not there were territorial distinctions involved. What little I do have suggests that though the animals trapped were the personal property of the individuals involved, there were apparently no territorial claims attached to the areas as such, as a consequence of their being fire maintained by individuals or families.

19. All of those who acknowledged such a practice were either from the northern part of the boreal forest or the Rocky Mountain foothill region, both areas having less parkland than that of the region to the south and east. Because of their relative scarcity, I would expect that the making of meadows was more characteristic of northern and mountain portions of the boreal forest but could not claim this strictly on the basis of the interviews reported here.

20. Suggested by Arthur W. Bailey, Department of Plant Science, University of Alberta, to the author in personal communication.

21. This kind of burning was mentioned when an older informant from the wooded portions of the Peace River complained about the green firewood that was burning badly and noisily as we talked. He complained of how long it took to dry out wood and that it was never as good as wood that was fire dried.

22. Feit's (1973) study of the "ecological system of knowledge" employed by the Waswanipi of Quebec considers this particular feature of Cree thought and behaviour in greater detail. The broad, interrelated perspectives which northern Alberta Indian informants employed towards environmental phenomena were brought out again and again.

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